GOVERNMENT TECHNICAL ASSISTANCE PROGRAMS* AND PLANT SURVIVAL: THE ROLE OF PLANT OWNERSHIP TYPE

By

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CES 99-2 February 1999

Abstract

This paper compares the survival rates of plants participating in manufacturing extension programs to nonparticipating plants. Participating plants receive technical and business assistance from one of a nationwide network of extension centers intended to assist smaller manufacturers. Results suggest that plant survival is related to plant size, age, productivity, capital intensity and ownership type. Importantly, the impact of extension services differs across ownership types. Participating in extension increases the probability of survival for single unit plants, but not for multi units. This result is consistent with the notion that single unit plants have less access to information on new technologies and would, therefore, benefit more from technical assistance programs such as manufacturing extension.

*****This research was funded by the National Institute of Standards and Technology's Manufacturing Extension Partnership. I would like to thank Timothy Dunne and C.J. Krizan for helpful comments. An earlier version of this paper was presented at the Asia-Pacific Economic Cooperation (APEC) "Symposium on the Evaluation of Science and Technology Programmes Among APEC Member Economies" in Wellington, New Zealand. Any findings, conclusions or opinions expressed here are those of the author and do not necessarily reflect the views of the Census Bureau or NIST.

I. INTRODUCTION

Plant exit is a normal and important part of restructuring in a market economy (see Baily, Hulten and Campbell, 1992, Olley and Pakes, 1996, and Davis, Haltiwanger and Schuh, 1996). Nevertheless, the effects of plant closings can be quite detrimental on workers and their communities (see Carrington, 1993). Large manufacturing plant closings and the resulting loss of "good" jobs often receive a lot of media and public attention. Thus, it is understandable that policymakers would like to mitigate the painful consequences of these events.

This generic policy goal extends even to programs with different stated policy objectives. An example in the United States is the National Institute of Standards and Technology's (NIST) Manufacturing Extension Partnership (MEP). The MEP provides technical and business assistance to the nation's small and medium sized manufacturers (or SMEs)[1]. As the name implies, the program is loosely modeled after agricultural extension. The MEP's primary policy objective is to improve the productivity and competitiveness of the nation's SMEs.

The MEP was established due to a perception that there is a large and growing performance gap between large manufacturing plants and SMEs. Further, extension proponents have argued that this gap exists because SMEs have less access to modern manufacturing technologies and business practices than do their larger counterparts (see National Research Council, 1993, and Feller, 1997). Kelly and Brooks (1991) and Dunne (1994) find evidence that smaller establishments are less likely to adopt advanced manufacturing technologies than are larger plants. Kelly and Brooks argue that this is because SMEs have fewer external information sources than large manufacturing establishments. The MEP addresses this issue directly by providing unbiased and up to date information on technologies and business practices that are appropriate for each individual client.

As in agricultural extension, there is a large outreach component to manufacturing extension. Although individual extension centers have a lot latitude in choosing the services they provide and who they target them to, services they commonly provide include changes in plant layout, process redesign, consulting on software selection, preparation for ISO-9000 certification

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[1] NIST/MEP uses the Small Business Administration's definition of SMEs: plants with between 20 and 500 workers.

and marketing assistance[2].

Several empirical analyses comparing the performance of manufacturing extension clients to control groups of non-clients, as well as a large number of case studies, have found that manufacturing extension has positive impacts on client productivity.[3] However, given the Government Performance and Results Act of 1993 and the current overall budgetary climate, federal program managers are under increasing pressure to demonstrate as many program benefits as possible. Thus, managers at NIST/MEP are interested assessing the affects of extension programs on the survival of client manufacturing plants. Plant survival is a natural metric to evaluate the impact of extension since the goal of NIST/MEP is to improve the competitiveness of small and medium sized manufacturers. We expect more competitive plants to survive longer.

In this paper, I examine the affect of services provided, between 1987 and 1992, by nine manufacturing extension centers, in three states, on the survival of client plants between 1992 and 1996. To do this, I match client data provided by the extension centers to confidential Census Bureau micro data for manufacturing plants from the three states. I then compare the probability of survival across client and non client plants, while controlling for observable characteristics that are associated with plant survival. Previous empirical studies find that plant survival varies with plant size, age and ownership type (Dunne, Roberts and Samuelson, 1989), productivity and capital intensity (Doms, Dunne and Roberts, 1995, and Olley and Pakes, 1996) and on a number of firm characteristics in the case of multi-unit plants (Lieberman, 1990 and Deily, 1991).

The empirical literature on plant survival treats plant ownership in a variety of ways. The two types of plant ownership of interest here and in the literature include: i) single unit plants which are owned by firms operating in only one location and ii) multi unit plants which are owned by firms that operate in multiple locations. Dunne, Roberts and Samuelson (1989) recognize that the determinants of plant exit (survival) may differ across ownership types and estimate their model of plant exit on single and multi unit observations separately. The important lesson

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[2] See NIST (1997) for a collection of case studies that describe individual projects in more detail.

[3] For examples see Nexus Associates (1996), Shapira and Youtie (1997) and Jarmin (1998 and 1999). The methodologies and results of several of these studies are reviewed in Jarmin and Jensen (1997).

to take from their analysis is that the impact of other observable plant characteristics on the probability of plant exit differs across ownership types. Other studies control for ownership type in plant exit models estimated with observations for single and multi unit plants pooled together. For example, Dunne and Roberts (1990) find weak evidence that multi-units are more likely to exit controlling for other plant characteristics. Lieberman (1990) finds little difference in the exit behavior of single and multi unit plants. However, his results might not generalize beyond the set of declining chemical processing industries for which his data apply. Still other studies (Lieberman, 1990 and Deily, 1991) recognize that firm level characteristics may be important determinants of multi unit plant survival.

The role of ownership type is especially important for this study, since we might expect that the impact of manufacturing extension on plant survival to differ between single and multi unit plants. First, following the logic of Kelly and Brooks (1991), it is likely that single unit SMEs will have more demand for the services provided by manufacturing extension centers since they do not have access to technical information from a larger parent firm, as is the case with multi unit SMEs. For example, Jarmin (1999) finds evidence that single unit plants are more likely to become extension clients, controlling for other plant characteristics, than are multi units. Second, extension services likely affect client plant survival by first improving the plant's productivity and competitiveness. Thus, an equal improvement in productivity could lead to different changes in the probability of survival across comparable single and multi unit plants.

Because of the differences in the survival patterns of single and multi unit plants, I estimate reduced form survival probits for both pooled and separate single and multi unit samples. In addition to testing whether manufacturing extension has an impact on plant survival, and if this impact differs across ownership types, the analysis below extends the empirical literature in plant survival (exit) by more carefully examining the plant characteristics associated with survival across ownership types.

A number of interesting results emerge from the analysis. For both single and multi unit plants, survival is function of plant size and productivity. In the case of multi-units, firm level characteristics are important correlates of plant survival. In general, no significant relationship between participating in manufacturing extension programs and plant survival is found for multi-units. In the case of single-units, when I control for 1992 characteristics no significant impact is found. However, 1992 characteristics are endogenous for client plants, and when I use 1987 characteristics as instruments I find a significant positive impact of extension services on single-unit plant survival. I also find other important differences between single and multi unit plants. In the pooled probits, I find that multi unit plants are more likely to shut down than single unit plants, all else equal. Also, plant age appears to be a more important determinant of plant survival for single unit plants than it is for multi units. Finally, urban multi unit plants are more likely to fail than are rural multi units, whereas, there is no difference in urban and rural failure rates for single unit plants.

II. MODEL

The premise behind manufacturing extension is that small and medium sized manufacturers do not have access to information on up to date technologies and business practices and, therefore, lag in their adoption and use of these. Through education and outreach, manufacturing extension centers seek to help bridge the information gap for SMEs.[4] The idea is that with this additional information, SMEs will make choices that lead to better outcomes than would have occurred in the absence of assistance from a manufacturing extension center.

More formally, the objective of each firm i is to choose actions, A_{it}, given characteristics, Y_{it}, to maximize its discounted profit stream,

$$\begin{aligned} V_{it} &= \pi_{it}(A_{it},Y_{it}) + \delta_i V_{it+1} \\ s.t.\quad Y_{it} &= f(Y_{it-1},A_{it-1}) \end{aligned} \qquad \textbf{(1)}$$

where V_{it} is the value of the firm's profit stream in period t[5]. The firm's single period profit function is given by π_{it} and depends on the firm's current period actions and beginning of period characteristics. The function *f* describes how the firm's characteristics (e.g., capital intensity, size, age etc.) evolve over time. Namely, the firm's characteristics are a function of its last

[4] Particularly important for the SME population, who may not completely trust vendors and consultants, is the manufacturing extension center's role as an honest broker.

[5] This model is an abbreviated version of the model in Jarmin and Jensen (1997). That model is used to more thoroughly discuss how manufacturing extension services and other government technology programs impact client plants and firms and how these impacts can be assessed with available data.

period characteristics and the choices it made regarding last period actions (e.g., output levels, investment, input usage, wages and prices and even whether to participate in manufacturing extension). Thus, current period actions affect next period characteristics and profits. Discounted future profits are captured in $*_i V_{it+1}$ where $*_i$ is a firm specific discount factor.

We can use the model in (1) to see how manufacturing extension services might affect the profitability and survival of client plants. First, assume that as long as its expected discounted profit stream is positive, a plant will remain active. Thus, enhancing profitability also enhances survival.

Now say a plant participates in extension in year t and, for example, undertakes investment in cost saving new machines on the advice of the one of the extension center's field engineers. The profit maximizing firm undertakes these actions because it believes they will improve the plant's capital stock and enhance its profitability and survival in subsequent periods.

Empirically demonstrating that participation in manufacturing extension causes improved performance is a tall order, however. In the above example, this requires estimating a dynamic structural econometric model. The model should include participation, investment and profit (survival) equations. One must show both that the investment in new machines is responsible for the increased profits (survival), and that the investment resulted from participation in manufacturing extension.

Unfortunately the data required to estimate such models are not available[6] . Thus, I specify reduced form models below where I relate establishment survival to participation in manufacturing extension programs, while controlling for several other characteristics that are associated with profitability and survival.

The timing of the services received by the clients in the sample used here and the available Census of Manufactures data pose some estimation problems. In the reduced form

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[6] Such a model would require annual (or more frequent) data over a period long enough to see plants participate in manufacturing extension, observe impacts on plant characteristics and then still have a period long enough to observe some plants exit. The client plants in the data set used in this paper were all active in 1992 and most received services in the early 90's. Annual data are only available for plants with more than 250 employees and a probability sample of smaller plants from the ASM (Annual Survey of Manufactures). The 89-93 ASM panel could be used to estimate a dynamic structural model, except for the fact that very few clients exited by 1993. Using a longer panel comprised of the 89-93 ASM panel and the available years of the 94-98 panel is problematic since the small plants in the 89-93 panel are excluded from the 94-98 panel. This excludes most of the SME population targeted by manufacturing extension.

regressions, I want to test whether extension clients are more likely to survive from 1992 to 1996, while controlling for plant level differences in several characteristics associated with plant survival, such as size, age, productivity and so on. The issue is when to measure these other characteristics. Since the dependent variable in the all regressions is whether plants that were active in 1992 are still active in 1996, measuring the control variables in 1992 is an obvious choice. This amounts to conditioning survival on beginning of period characteristics, and is what is typically done in the literature (e.g., Doms, Dunne and Roberts, 1995).

In the present case, however, this measurement strategy may result in estimates that understate the impact of manufacturing extension on plant survival. Namely, the client plants analyzed here received services between 1987 and the end of 1992. As mentioned above, the impact of extension services on plant survival is not likely to be direct. Rather, extension services induce plants to take actions that lead to changes in observable and unobservable characteristics that, in turn, influence the plant's chances for survival. Thus, 1992 observable characteristics may not be exogenous for extension clients, since the services they received may have influenced some or all of the observable characteristics used as control variables. Including measures of plant characteristics, such as productivity, that might have been influenced by extension services in the regressions, may wash out any impacts that would otherwise be picked up by the extension variable. Thus, I estimate regressions where I both control for 1992 characteristics and where I use 1987 characteristics as instruments.

In specifying models of plant survival, it is important to distinguish between two types of plant ownership. Most plants are "single unit" establishments, where there is no distinction between the plant and the firm. This is not the case with "multi unit" establishments which plants are owned by firms that own plants in multiple locations. The decision to close a single unit plant is equivalent to the firm going out of business. This is likely to differ substantially from the decision of a multi unit firm to cease operations only at one particular location. This may be due, for example, to differences in the nature of the sunk costs (exit barriers) faced by multi and single unit plants.

Because of these differences, Dunne, Roberts and Samuelson (1989) estimate separate regressions for multi and single unit plants. Other than that, however, they treat multi and single unit plants symmetrically, as the specifications of both regression models are the same. Empirical studies by Lieberman (1990), and Deily (1991) suggest that firm level characteristics play an important role in plant closing decisions. Economic theory also predicts that firm characteristics are a factor in plant closing decisions. The simple behavioral model given below highlights the differences in the exit decisions of multi and single unit plants and shows that they should be treated differently in the empirical analysis below.

A. Single Unit Model

Since the single unit case is the most straightforward, I consider it first. By definition, there is no difference between plant and firm objectives for single units. Thus, the plant will remain active as long as its expected discounted profit stream is non-negative (i.e., $E(V_{it})$ $\$$ 0). Now define an index, I_{it}, such that,

$$\begin{aligned} I_{it} &= 1 \text{ if } E(V_{it}) \geq 0 \\ I_{it} &= 0 \text{ if } E(V_{it}) < 0 \end{aligned} \tag{3}$$

Next, assume that V_{it} is a function of observable plant characteristics so that we can write the following reduced form econometric model

$$V_{it} = X_{it}b + u_{it} \tag{4}$$

where u_{it} is an error term that captures the impact of unobserved and random factors that affect profits. We do not observe V_{it}. We do, however, observe whether the plant is active (i.e., we observe I_{it}). Thus, we get the following model

$$\begin{aligned} &\text{Prob}(I_{it} = 1) = \text{Prob}(V_{it} \geq 0) = \\ &\text{Prob}(u_{it} \geq -X_{it}b) = 1 - F(-X_{it}b) \end{aligned} \tag{5}$$

where $F(\cdot)$ is the cumulative distribution function of the random error term, u_{it}. Assuming u_{it} is distributed normally, we can estimate the parameter vector, $\$$, with the following model via probit maximum likelihood where the superscript s denotes single-unit observations.

$$I^{s}_{it} = X^{s}_{it}b^{s} + e^{s}_{it} \tag{6}$$

Doms, Dunne and Roberts (1995) control for plant size, age, productivity and capital intensity in regressions like (6). I control for these and add variables indicating participation in manufacturing extension and whether the plant was located in an urban or rural area.

B. Multi Unit Model

Now consider the case of multi unit plants. The objective of multi unit firms is to maximize the discounted profit stream of the entire enterprise and not necessarily that of individual plants. Further, firm profits may not be a simple additive function of establishment profits. Thus, plant level measures of profitability may not be sufficient to explain multi unit plant survival.

A multi-unit firm will keep a given plant open as long as firm profits are higher than they would be if the plant was closed. That is, the i^{th} plant of the j^{th} firm will remain active if

$$V_{jt}\left(I_{ijt}=1\right) = X_{jt}b + u_{jt} \geq V_{jt}\left(I_{ijt}=0\right) = X_{jt}^{*}b^{*} + u_{jt}^{*} \qquad (7)$$

where the X_{jt}'s now include firm as well as plant characteristics. As above, the probability that plant i is active in period t is given by

$$\begin{gathered} \text{Prob}(I_{ijt}=1) = \text{Prob}(V_{jt}(I_{ijt}=1) \geq V_{jt}(I_{ijt}=0)) = \\ \text{Prob}(u_{jt} - u_{jt}^{*} \geq X_{jt}^{*}b^{*} - X_{jt}b) \end{gathered} \qquad (8)$$

The expression in (8) calls for comparing firm j's profits with and without plant i. We do not observe both scenarios, but we do observe whether plant i survives or not. Thus, the best way to empirically analyze a multi-unit firm's decision to close plants is to use the plant as the unit of analysis and control for both plant and firm characteristics. Thus, I use the following probit model to examine the relationship between manufacturing extension and survival for multi-unit establishments

$$I_{it}^{m} = X_{it}^{m}b^{m} + e_{it}^{m} \qquad (9)$$

where the superscript m denotes multi-unit observations. The control variables include all those for the single unit case plus a number of firm characteristics discussed below.

DATA

The data for this study come from 2 sources. First, manufacturing extension client data come from nine manufacturing extension centers located in three states. NIST/MEP arranged to have these centers provide client records on a confidential basis. The nine extension centers provided just under 12,000 project level records from 4,185 establishments[7]. I use these data primarily to identify extension clients in the second data source, confidential micro data records housed at the U.S. Census Bureau.[8]

This study requires data from two Census Bureau data sets: i) the Longitudinal Research Database (LRD) and ii) the Standard Statistical Establishment List (SSEL). The LRD is constructed by linking plant level data from the Censuses and Annual Surveys of Manufactures. Due to its comprehensive and longitudinal nature, the LRD is an excellent resource for evaluating the impact of government programs on manufacturing establishments. Most of the data items used in the analysis below are taken from the LRD. Specifically, data from the 1992 and 1987 Censuses of Manufactures are used as independent variables in the probit regressions discussed above.

The SSEL is the Census Bureau's business register which it uses as the mailing list for economic censuses and surveys[9]. It is compiled from administrative sources and from the bureau's economic census and establishment and firm survey activities. It contains the universe of tax paying employer[10] business establishments in the U.S., including those smaller establishments not sent forms during the quinquennial economic censuses.

The SSEL has a duel purpose in the present analysis. First, I exploit the SSEL's name and address information to match it to the client records from the nine manufacturing extension

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[7] Although all of the nine centers that contributed client records used in this study are now affiliated with NIST/MEP, not all of them were during the 1987-1992 period to which the records apply. The centers that contributed the data used here are older and larger than the typical center in the current MEP system. Further, the 1987-1992 period pre-dates the establishment of the current nationwide system. On should, therefore, be cautious about drawing system wide conclusions from this analysis.

[8] The micro data sets used here are housed at the Census Bureau's Center for Economic Studies (CES). These data are confidential and can be accessed only by Special Sworn Employees (not necessarily Census Bureau employees) at CES (in Washington, DC) or at Research Data Centers in Boston, Pittsburgh, Los Angeles or Berkeley, CA. For more information on accessing these data see www.census.gov/ces/ces.html.

[9] The SSEL also serves as the basis for the Census Bureau's County Business Patterns Program.

[10] The Census Bureau also maintains a list of non-employer businesses. As the name implies, these businesses have no employees.

centers. I was able to match 2,977 of the 4,185 (or 71.1%) of the establishments identified by these centers as extension clients to the 1992 SSEL. The SSEL was used for this purpose since the LRD does not contain names and addresses for matching. The LRD and the SSEL share common establishment identifiers that facilitate linking the matched client records to the LRD.

The other use of the SSEL in this paper is to determine which of the establishments present in the LRD in 1992 (i.e., in the '92 Census of Manufactures) are still active in 1996. Data from the 1997 Census of Manufactures (CM) are not yet available, so the most current information on active establishments is in the 1996 SSEL. To tell whether plants that were active in 1992 are still active in 1996, the 1992 CM must be matched to the 1996 SSEL. I do this for all manufacturing plants located in the three states in which the nine manufacturing extension centers are located.

The primary way to track establishments over time in the LRD and SSEL is to use the Permanent Plant Number (PPN). Each establishment in the SSEL is assigned a PPN which is designed to remain the same as long as the establishment remains in operation in the same physical location. The nature of the PPN contrasts with the other primary establishment identifier in these data sets, the Census File Number (CFN), which can change as a result of events like ownership changes.

However, a few characteristics of the SSEL complicate tracking plants over time. First, a plant that died prior to 1996 could still have a record with its PPN in the 1996 SSEL. This is because Census Bureau processing allows an inactive establishment to remain in the SSEL for 9 quarters before it is completely removed from the file. Inactive establishments that are still in the SSEL typically will have zero employment and payroll, as well as, other codes indicating inactivity. Thus, to perform the analysis I restrict attention to establishments in the 1996 SSEL that have positive employment and payroll and activity and source codes[11] that indicate the record applies to an active establishment.[12]

The other complicating characteristic of the SSEL for tracking plants over time is that valid PPN (i.e., establishment) links can be broken due to processing errors. Common causes of these errors include ownership changes, changes in tax filing status and plants switching

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[11] See Doms and Peck (1994) for more information about codes in the SSEL.

[12] This reduces the number of establishment records in the SSEL from just over 12 million to approximately 6.3 million.

between multi and single unit status. This problem overstates the number of establishment births and deaths. There is no precise estimate of the magnitude of this problem, but it is possible that between 10 and 20% of the manufacturing establishment births and deaths based on PPN linkages between two Censuses of Manufactures (i.e., over five years) are erroneous.

Fortunately, the name, address, SIC code, employment, and other fields in the SSEL can be used to repair broken PPN linkages by linking establishments between two SSEL files. To do this, I first matched the 1992 CM to the 1992 SSEL using the CFN, the most reliable "within" year establishment identifier. Then I used AUTOMATCH, a sophisticated commercial statistical matching software package, to see if any of the plants that weren't matched between 1992 and 1996 via PPN could be matched by name, address, and other information.

The 1992 CM has 46,758 plants in the three states where the extension centers examined here are located. Of these, 34,549 (73.9%) plants could be matched to the 1996 SSEL using PPN. I was then able to match 729 of the 12,209 plants that did not match by PPN using AUTOMATCH to perform a name and address match.

Thus, 6.0% of the plant deaths according to a PPN match between the 1992 CM and the 1996 SSEL where shown to be false. This, is considerably less than the estimated 10 to 20% false death rate. However, I used a very conservative matching algorithm and kept only verified matches. This is one of the first analyses to employ AUTOMATCH software to fix PPN linkages and improvements to the matching algorithm will surely come that may increase the number of repaired linkages.[13]

Approximately 74% of 34,549 continuing plants with valid PPN links between 1992 and 1996 are single units. This share rises to 83.4% for the 729 continuing plants with broken PPN linkages that I was able to repair via name and address matching. Thus, as expected, the SSEL has more difficultly tracking single unit plants over time. Also, 99.6% of the 729 repaired plants

[13] Other studies that have tried to repair broken PPN linkages include Krizan (1998) and Foster, Haltiwanger and Krizan (1998). In the latter study, the authors were able to match 17.6% of the auto repair establishments that were in the 1987 Census of Services Industries but were not in the 1992 Census. Two factors may contribute to their higher match rate. First, establishments in non-manufacturing industries have never been analyzed longitudinally and the quality of the PPN linkages in these sectors may not be as good as in manufacturing. Second, the authors employed a considerably more liberal matching algorithm than I did. Thus, I missed more valid matches and they probably picked up more invalid matches. The correct algorithm is probably somewhere in between. Note that, at this point, these matching exercises are strictly experimental and no repaired PPN linkages have been incorporated into the LRD/SSEL.

had a change in CFN over the 1992 to 1996 period. This compares to only 5.29% of the plants with valid PPN links between 1992 and 1996 experiencing changes in their CFN. Thus, PPN linkage problems in the SSEL appear to be closely related to phenomena, such as ownership changes and reorganizations, that cause changes in the CFN.

EMPIRICAL RESULTS

Are plants that participated in manufacturing extension between 1987 and 1992 more likely to still be active in 1996 than nonclient plants? Table 1 lists survival rates for the 1992 to 1996 period for client and nonclient plants by several establishment classifications. The first two columns show results for all plants in the 3 states analyzed here. The last two columns omit administrative record establishments and other establishments with missing or bad data.

The probit regressions below are estimated for non-administrative record establishments only. Many small establishments (those with fewer than 5 workers) are not sent forms during economic censuses in order to reduce their reporting burden. For these plants the Census Bureau uses information from administrative sources for some basic data items such as payroll, employment, industry and location. However, most data items available in the LRD are imputed for these establishments. Thus, it is not possible to reliably measure the capital stocks and productivity levels of these plants and they are, therefore, excluded from the regressions.[14] I also drop observations for 546 extension clients that did not complete a project with a manufacturing extension center prior to the end of 1992.

First consider the all plant results in the first two columns of table 1. The first row lists unconditional survival rates and shows that 86.3% of client plants in the LRD in 1992 were still active in 1996 versus 75.7% of the nonclient plants. This 10.6% difference shrinks considerably when controlling for factors such as establishment size, age and ownership type. However, extension clients still have higher survival rates within each classification except for a couple size classes. This includes a 2.5% differential for the 20 to 499 employee size class which is the SME population targeted by manufacturing extension programs.

When I exclude administrative records, the unconditional difference between client and non-client survival decreases considerably. Looking within the various classifications, however,

[14] In results not reported here, I ran the same regressions as in the tables including administrative records cases. The results (especially in the weighted probits) are very similar.

it appears that clients still have higher survival rates than non-clients.

A. Pooled Estimation Results.

Tables 2-A and 2-B contain coefficient estimates from probit regressions on the pooled single and multi unit samples. Table 2-A contains regressions with 1992 plant characteristics and table 2-B contains regressions where I control for the possible endogeniety of 1992 client characteristics by using 1987 values as instruments. Within each table, I estimate two sets of regressions for various samples based on plant size: All Plants and SMEs. I estimate both unweighted and weighted probits for each sample. The unweighted probits treat each establishment symmetrically. However, from a public policy perspective, the death of a large plant is a much worse outcome than the death of a small plant since it displaces more workers. Thus, I also estimate weighted probits where workers are treated symmetrically (the weights are employment share weights).

The results in tables 2 A and B show that plant survival is significantly associated with plant age and size as in Dunne, Roberts and Samuelson (1989). Plant survival is also positively associated with capital intensity and productivity as in Olley and Pakes (1992) and Doms, Dunne and Roberts (1995). The productivity result is of particular interest for manufacturing extension. As noted above, the primary policy objective of NIST's Manufacturing Extension Partnership is to improve the productivity and competitiveness of the nation's SMEs. The results in tables 2 A and B (and the rest of the paper) confirm that more productive plants are more likely to survive. This finding coupled with previous results that participation in manufacturing extension is associated with improvements in productivity, is suggestive that extension services indirectly enhance the probability that client plants survive via direct impacts on client plant productivity.

Now turn to the estimated coefficient on the extension dummy. Recall that this variable is simply an indicator for whether a plant participated in manufacturing extension between the years of 1987 and 1992[15]. Participation can have no real impacts on performance unless it induces the plant to take actions that lead to performance improvements. In the case of the

[15] One might like to use a measure of program participation that measures the "dosage" of the treatment more precisely. This might include information on both the nature and intensity of the services provided individual clients. Some information like this is available for a subset of the client plants examined here. Unfortunately, the data is not directly comparable across clients served by different centers. NIST/MEP has instituted new reporting requirements that are in place now and will make this type of analysis easier in the future.

reduced form survival probits estimated here, these actions will impact observable and/or unobservable plant characteristics that in turn affect the plants chances of surviving until 1996. In the regressions in table 2-A, I control for observable plant characteristics measured in 1992. It is likely that extension services provided before the end of 1992 had some impact on these variables, as the previous studies on extension and productivity suggest. Therefore, any impact of manufacturing extension on plant survival that is transmitted via these variables will be washed out by including them in the regressions. The extension coefficient, thus, picks up impacts transmitted via unobserved or lagged observable characteristics and will likely understate the total impact of extension services on plant survival.

That being said, the results in table 2-A show that, while positive in each case, the coefficient on the extension variable is statistically significant in only one case. This suggests that either a) the impact of manufacturing extension on plant survival is weak, or b) the impact is not transmitted by unobserved or lagged observable variables and is instead transmitted by observable variables, such as productivity and size, and that the inclusion of these washes out the impact of the extension variable.

To see if the explanation is the latter, I use 1987 values of the observable plant characteristics as instruments in the probit regressions in table 2-B. Here we see that the estimated coefficients on the extension variable are all positive and significant. This suggests that endogeniety is a problem in the regressions in table 2-A. To see if the differences between tables 2-A and 2-B were due to the necessary fact that I have a smaller sample when using 1987 characteristics, I estimated regressions using 1992 characteristics and the sample from table 2-B. The results not reported here were virtually the same as in table 2-A suggesting that sample choice is not what is driving the differences.

Finally, probit coefficients are difficult to interpret so I computed marginal probabilities at the sample means for the regressions in table 2-B. For the unweighted probits these suggest that plants that participated in manufacturing extension were between 2.5% and 3.5% more likely to survive from 1992 to 1996 than non-clients. In the case of the weighted probits, the results suggest that workers at plants participating in extension were between 1.7 and 2.1% less likely to be employed at a failing plant.

B. The Role of Ownership Type

The results in tables 2-A and 2-B show that plants owned by multi unit firms are more likely to fail all else equal. Computed marginal effects for the probits in tables 2-A and 2-B indicate that multi unit plants were between 5.4 and 6% more likely to close between 1992 and 1996 than were single unit plants and that workers at multi unit plants were between 3.0 and 4.1% less likely to work at failing plants. Dunne, Roberts and Samuelson (1989) report coefficients that suggest that multi units are about 4.5% more likely to fail controlling for size and age in their separate cell based regressions for single and multi units. They do not discuss this result or provide a standard error for the estimate, and their methodology differs substantially from mine. Nevertheless, their estimate lies right in the middle of my range of estimates. These results are in contrast to a large survival premium for multi unit plants seen when looking at the unconditional survival rates listed in the first two columns of table 1. Clearly, this difference can be largely attributed to differences in the observable characteristics of single and multi unit plants.

This can be seen in table 3 which lists survival rates for single and multi unit plants by size and age categories. For both the sample including administrative records and the one excluding them, multi unit plants have a lower survival rate, within size classes, than do single unit plants. The general perception is that large multi unit plants dominate smaller single unit plants in a number of performance measures including survival. However, the results in table 3 suggest that this may be due more to the size of multi unit plants than to their multi unit ownership status. Unfortunately, there are so few large single unit plants in this sample that its difficult to discern the role of ownership status for plants with more than 500 employees.

Table 3 also compares single and multi unit survival rates by age class. When administrative records are included, multi unit survival rates exceed single units. If we restrict attention to the regression sample, we see that single unit plants have higher survival rates in the older age categories. Also, the age premium (the difference between the survival rate for the oldest and youngest groups of plants) for single unit plants is more that double that for multi units.

The results in tables 2 and 3 highlight substantial differences in the survival patterns of single and multi unit plants. The theoretical literature offers little insight into what is at the root of these differences. Ghemawat and Nalebuff (1985) provide a model of competition in a declining industry in which large firms (perhaps multi units) have an incentive to exit the industry first. Whinston (1988), however, shows that this result does not hold for multi unit firms if the firms are allowed to close plants incrementally. In either case, the assumptions required to generate predictions in these models are very restrictive. Models with heterogenous plants and market selection (Jovanovic, 1982 and Olley and Pakes 1996) appear to fit the data pretty well. In particular, the results here and elsewhere (Dunne, Roberts and Samuelson, 1989 and Olley and Pakes, 1996) confirm that plant survival increases with plant size, age and productivity as predicted by the selection models. Unfortunately, these models say little about the role of ownership type in plant survival.

In particular, these models predict that low productivity plants are more likely to fail. Table 4, however, shows that multi unit deaths were more productive in 1992 than single unit survivors within size, age and other categories. This suggests that multi unit firms impose a higher performance standard on their plants than do owners of single unit plants[16], a result that is at odds with market selection models. Could this partially explain lower survival rates for multi unit plants? Its not clear why owners of single unit plants would use a lower shut down threshold. One plausible explanation is that they face relatively higher sunk costs. These could perhaps arise from some fixed entrepreneurial human capital held by the owners of single unit plants. Whatever the source, the exit behavior of multi and single unit plants is sufficiently different to merit estimating separate survival probits for each ownership type.

B. Single Unit Probits

Tables 5 A and B contain results from probits estimated for single-unit establishments only. The results show that survival for single unit plants is associated with productivity, capital intensity , size and age. Again, when using 1992 characteristics, the extension coefficient is nearly zero and insignificant. However, when I use 1987 values as instruments, we find that extension has significant and positive impacts on the survival of single-unit establishments. The associated marginal probabilities suggest that single unit extension clients are between 2.4 and 4.1% more likely to survive from 1992 to 1996 than are non client single unit plants.

C. Multi-Unit Probits

Tables 6 A and B and 7 A and B list the results from probit regressions estimated for multi-unit establishments only. Tables 6 A and B contain results where I estimated the

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[16] This difference persists after controlling for 2, 3 and 4 digit industry.

regressions using only plant specific characteristics as right hand side variables. In tables 7 A and B, I also include firm level variables in the regressions.

Before comparing the multi and single unit results, consider the role of firm characteristics in plant level survival equations. From the results in table 7, it is clear that firm level characteristics are important factors in establishment survival. The firm characteristics in the regressions include: a measure of firm profitability,[17] the plant's share of the firm's total manufacturing employment, a measure of the firm's degree of horizontal integration (i.e., the number of plants the firm operates in the same 4 digit SIC industry as the observation plant), a measure of firm diversification (i.e., the number of manufacturing 2 digit SIC major groups in which the firm operates) and firm size. Note that all firm level measures are constructed nationally and are not restricted to the three states in which the plants in the sample analyzed here reside.

The results in tables 7 A and B suggest that multi-unit plant survival is negatively associated with firm profits and positively associated with the plant's share of total firm employment. The second result conforms with expectations, but the profitability result is puzzling. One would expect plants owned by profitable firms to be more likely to survive.

The results in tables 7 A and B also suggest that establishments owned by firms with many plants in the establishment's 4 digit SIC industry are more likely to survive. This may be because firms with many plants in an industry are very successful in that industry and thus, the plants are each more likely to survive. Although they are often estimated imprecisely, the coefficients on the firm size dummies suggest that plants belonging to smaller firms are at greater risk of failure. However, the relationship between firm size and survival is not monotonic. This is similar to the findings in Deily (1990). Finally, we see that plants owned by diversified firms are more likely to survive, all else equal. This result differs from Deily (1990) who finds no effect of firm diversification on the failure of steel plants.

Comparing the results in tables 6 and 7, we see that, while many firm characteristics are associated in some way with plant survival, the inclusion of firm level controls does not significantly affect the coefficients on plant level characteristics. Namely, the estimated coefficients on the extension, productivity, and capital intensity variables are pretty similar in tables 6 and 7, as are their implied marginal impacts.

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[17] This is measured as the firm's gross margins as a percent of firm shipments for its manufacturing operations. Gross margins are computed as value added less labor costs.

D. Differences Between Single and Multi-Unit Plants

There are several important differences between the results for multi-units in tables 6 and 7 and the single-unit results in table 5. First, urban multi-unit plants are more likely to fail than non-urban multi-units, whereas there is no significant difference between urban and non-urban single units plants. This is especially the case for urban multi-unit SMEs. This result may reflect the trend of manufacturing activity moving from traditional industrial centers, such as the urban areas of old industrial states (two of the three states analyzed here are “industrial” states), to less congested, lower wage locations, in rural areas, or to the South and West. This trend is more likely to affect relatively more footloose multi-unit plants.

Second, plant age appears to be a more important factor in the survival of single unit establishments. Note that for single units, firm and plant age are the same thing and that I do not control for firm age for multi-units. Nonetheless, multi-unit plants owned by established firms are likely to have access to more experience and expertise than single-unit plants of the same age. As a result, multi unit plant survival may depend much less on plant level experience than is the case for single units.

The final major difference between the single and multi-unit regressions, and the one of most import for the current analysis, concerns the estimates for the extension variable. Generally, I find positive and significant impacts for single-units (when using 1987 characteristics). Importantly, extension services appear to enhance the survival probabilities of single-unit SMEs, the establishment population targeted by the MEP. In the case of multi-units, however, significant impacts are found only in a couple of instances. Further, manufacturing extension does not appear to benefit the survival of multi-unit SMEs. On the whole, these results support the notion, suggested by Kelly and Brooks (1991) that single-unit SMEs have less access to information than do multi-units and, therefore, might benefit more from extension services.

CONCLUSIONS

The goal of manufacturing extension programs in the United States is to improve the productivity and competitiveness of the nation’s small and medium sized manufacturers. Previous studies have found that these programs appear to improve the productivity of client plants. The Government Performance and Results Act, however, has lead program managers to try to demonstrate as many program benefits as possible. In this paper, I use plant level data to see if extension clients served between 1987 and 1992 were more likely than non-clients to survive from 1992 to 1996.

Previous studies using similar data found significant differences in the exit behavior of single and multi-unit establishments. Thus, I derive empirical models of plant survival from a simple model of firm behavior that imply different empirical specifications for the two types of plants. Namely, multi-unit survival probits should control for firm level, as well as, plant level characteristics. The results indicate that a number of firm level characteristics are associated with plant survival. However, the inclusion of firm level variables does not appear to significantly affect the estimated coefficients of the extension variable and other plant level variables.

Survival for both single and multi-unit plants is positively associated with plant age, size, productivity, and capital intensity. The productivity result combined with previous studies finding that manufacturing extension has positive impacts on client productivity suggests that extension has an indirect impact on survival via productivity.

The estimates of the extension coefficients are sensitive to when plant level control variables are measured. When I use 1992 values of size, productivity and so on, the estimated extension coefficient was often small and usually statistically insignificant. Since most clients were served prior to 1992, it is likely that extension services influenced the observable variables used as controls. That is, 1992 plant level characteristics are endogenous for extension clients. Thus, I re-estimated the probits using 1987 values as instruments for the endogenous plant characteristics. The single unit regressions using 1987 characteristics yielded positive and statistically significant estimates of the extension variable. Marginal probability calculations suggest that manufacturing extension clients were, in the neighborhood of 3%, more likely to survive from 1992 to 1996. The results for multi-units were statistically significant in only a couple of instances. Importantly, the survival of single-unit SMEs benefitted from extension service, whereas multi-unit SMEs did not. The results generally support the notion that single-unit plants have less access to outside information about modern manufacturing technologies and business practices than do multi-units and would, therefore, benefit more from programs such as manufacturing extension.

I find other important differences between single and multi unit plants. In the pooled probits, I find that multi unit plants are more likely to shut down than single unit plants, all else equal. Also, plant age appears to be a more important determinant of plant survival for single unit plants than it is for multi units. Finally, urban multi unit plants are more likely to fail than are rural multi units, whereas, there is no difference in urban and rural failure rates for single unit plants.

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Table 1
Client and Non-Client Survival Rates
(Plant Counts in Parentheses)

		All plants including Administrative Records		Excluding Administrative Records (Regression Sample)	
		Clients	Non-Clients	Clients	Non-Clients
All Plants		84.8 (1980)	74.2 (44,232)	87.1 (1758)	82.5 (25,884)
By Size Class					
	1-9	66.9 (184)	64.3 (21,286)	75.3 (73)	73.6 (5487)
	10-19	83.6 (207)	81.2 (7009)	86.1 (158)	82.6 (5443)
	20-49	84.6 (475)	82.8 (7311)	86.5 (431)	84.6 (6603)
	50-99	86.9 (373)	84.0 (3830)	87.4 (364)	85.3 (3650)
	100-249	86.3 (445)	84.2 (3025)	86.1 (439)	85.0 (2947)
	250-499	89.1 (175)	89.5 (1128)	89.1 (174)	89.7 (1118)
	500-999	98.8 (84)	93.3 (446)	98.8 (84)	93.2 (444)
	1000 +	91.9 (37)	96.5 (197)	94.3 (35)	96.9 (192)
	1-19	75.7 (391)	68.4 (28,295)	82.7 (231)	78.1 (10,930)
SMEs	20-499	86.2 (1468)	83.9 (15,294)	86.9 (1408)	85.3 (14,318)
	500 +	96.7 (121)	94.2 (643)	97.5 (119)	94.3 (636)
By Ownership Type					
	Single - Unit	83.7 (1122)	72.0 (34,137)	87.6 (912)	82.2 (16,249)
	Multi - Unit	86.3 (858)	81.4 (10,095)	86.5 (846)	82.9 (9635)
By Age in 1992					
	0 to 5 years	72.7 (344)	63.0 (16,377)	80.8 (250)	73.1 (6602)
	5 to 10 years	83.1 (290)	75.8 (7421)	84.0 (244)	81.6 (4314)
	More than 10 years	88.3 (1346)	82.5 (20,434)	88.9 (1264)	86.8 (14,968)

Table 2-A
Pooled Probit Estimates with 1992 Characteristics
Dependent Variable = 1 if plant survives from 1992 to 1996

	All Plants		SMEs	
	Unweighted	Weighted	Unweighted	Weighted
Constant	0.190** (0.081)	0.258*** (0.135)	0.610* (0.123)	0.460* (0.136)
Extension Client	0.022 (.0.043)	0.062*** (0.038)	0.011 (.0.049)	0.031 (0.045)
Age: 0 - 5 years	-0.367* (0.022)	-0.245* (0.031)	-0.285* (0.033)	-0.233* (0.037)
Age: 5 - 10 years	-0.134* (0.027)	-0.082** (0.036)	-0.141* (0.037)	-0.096** (0.041)
Age: over 10 years	-	-	-	-
Log(K/TE) (capital intensity)	0.045* (0.010)	0.140* (0.013)	0.067* (0.013)	0.116* (0.015)
Log(VA/TE) (labor productivity)	0.151* (0.015)	0.105* (0.018)	0.166* (0.021)	0.161* (0.021)
Urban	-0.034 (0.025)	-0.026 (0.027)	-0.064*** (0.033)	-0.067** (0.033)
Multi-Unit	-0.314* (0.023)	-0.291* (0.030)	-0.308* (0.030)	-0.276* (0.033)
Size: 1000#TE	1.463* (0.210)	1.489* (0.099)	NA	NA
Size: 500#TE<1000	0.985* (0.096)	0.831* (0.088)	NA	NA
Size: 250#TE<500	.741* (0.058)	0.614* (0.085)	.302* (0.057)	0.283* (0.048)
Size: 100#TE<250	0.529* (0.039)	0.417* (0.082)	0.095** (0.037)	0.086** (0.043)
Size: 50#TE<100	0.477* (0.035)	0.366* (0.083)	0.054*** (0.033)	0.036 (0.045)
Size: 20#TE<50	0.421* (0.028)	0.328* (0.083)	-	-
Size: 10#TE<20	0.312* (0.028)	0.212** (0.092)	NA	NA
Size: TE<10	-	-	NA	NA
N	27642	27642	15726	15726
Log L	-11264.0	-7650.0	-5822.0	-5457.9

* denotes coefficient estimate is significant at the 0.01 level, ** denotes significant at the 0.05 level and *** denotes significant at the 0.10 level. All probits also include 2 digit SIC and state dummies. Standard errors in parentheses.

Table 2-B
Pooled Probit Estimates with 1987 Characteristics
Dependent Variable = 1 if plant survives from 1992 to 1996

	All Plants		SMEs	
	Unweighted	Weighted	Unweighted	Weighted
Constant	0.281** (0.081)	0.202 (0.185)	0.358* (0.135)	0.448** (0.154)
Extension Client	0.122** (0.048)	0.114* (0.041)	0.174* (0.054)	0.107* (0.049)
Age: 0 - 5 years	NA	NA	NA	NA
Age: 5 - 10 years	-0.155* (0.028)	-0.064 (0.041)	-0.197* (0.037)	-0.093** (0.043)
Age: over 10 years	-	-	-	-
Log(K/TE) (capital intensity)	0.080* (0.014)	0.168* (0.017)	0.127* (0.017)	0.175* (0.019)
Log(VA/TE) (labor productivity)	0.103* (0.019)	0.130* (0.022)	0.124* (0.024)	0.129* (0.026)
Urban	-0.064** (0.028)	-0.072** (0.030)	-0.141* (0.035)	-0.115** (0.034)
Multi-Unit	-0.270* (0.028)	-0.209* (0.037)	-0.244* (0.033)	-0.205* (0.037)
Size: 1000#TE	0.563* (0.131)	0.649* (0.134)	NA	NA
Size: 500#TE<1000	0.732* (0.100)	0.636* (0.134)	NA	NA
Size: 250#TE<500	0.349* (0.062)	0.291** (0.131)	0.169* (0.058)	0.176* (0.053)
Size: 100#TE<250	0.245* (0.047)	0.209 (0.129)	0.087** (0.041)	0.099** (0.049)
Size: 50#TE<100	0.164* (0.043)	0.138 (0.130)	0.028 (0.036)	0.021 (0.051)
Size: 20#TE<50	0.121* (0.038)	0.119 (0.130)	-	-
Size: 10#TE<20	0.148* (0.040)	0.147 (0.142)	NA	NA
TE<10	-	-	NA	NA
N	19991	19991	12684	12684
Log L	-7922.1	-6148.7	-5041.4	-4858.2

* denotes coefficient estimate is significant at the 0.01 level, ** denotes significant at the 0.05 level and *** denotes significant at the 0.10 level. All probits also include 2 digit SIC and state dummies. Standard errors in parentheses.

Table 3
Survival Rates by Ownership Type
(Plant Counts in Parentheses)

		All plants including Administrative Records		Excluding Administrative Records (Regression Sample)	
		Single Units	Multi Units	Single Units	Multi Units
All Plants		74.4 (35,259)	81.8 (10,953)	83.0 (17,161)	83.2 (10,481)
By Size Class					
	1-9	64.1 (20,362)	68.1 (1108)	74.1 (4614)	71.4 (946)
	10-19	82.1 (6088)	76.4 (1128)	83.9 (4538)	77.6 (1063)
	20-49	84.3 (5634)	79.3 (2152)	86.2 (5004)	81.1 (2030)
	50-99	86.0 (2108)	82.5 (2095)	87.2 (1982)	83.9 (2032)
	100-249	84.4 (891)	84.5 (2579)	85.8 (849)	84.9 (2537)
	250-499	90.5 (158)	89.4 (1145)	91.0 (156)	89.4 (1136)
	500-999	100.0 (17)	94.0 (513)	100.0 (17)	93.9 (511)
	1000 +	100.0 (1)	95.7 (233)	100.0 (1)	96.5 (226)
	1-19	68.2 (26,450)	68.4 (28,295)	79.0 (9152)	74.7 (2009)
SMEs	20-499	84.8 (8791)	83.9 (15,294)	86.5 (7991)	84.3 (7735)
	500 +	100.0 (18)	94.2 (643)	100.0 (18)	97.7 (737)
By Age in 1992					
	0 to 5 years	61.3 (14,580)	75.9 (2323)	71.5 (4827)	78.0 (2161)
	5 to 10 years	75.4 (6192)	79.1 (1519)	82.4 (3097)	80.4 (1461)
	More than 10 years	82.3 (14,487)	84.3 (7111)	88.2 (9237)	85.5 (6859)

Table 4
Mean 1992 Labor Productivity by Ownership Type
Non Administrative Record Establishments Only
(Standard Errors in Parentheses)

	Deaths		Survivors	
	Single Units	Multi Units	Single Units	Multi Units
Size				
1 - 9	3.66 (0.021)	4.20 (0.057)	3.79 (0.011)	4.46 (0.035)
10 - 19	3.53 (0.025)	3.92 (0.052)	3.70 (0.010)	4.20 (0.026)
20 - 49	3.48 (0.027)	3.85 (0.042)	3.76 (0.009)	4.08 (0.018)
50 - 99	3.45 (0.053)	3.91 (0.047)	3.77 (0.015)	4.07 (0.018)
100 - 249	3.69 (0.065)	3.74 (0.038)	3.78 (0.022)	4.09 (0.015)
250 - 499	3.42 (0.146)	3.88 (0.067)	3.80 (0.045)	4.14 (0.024)
500 - 999	-	4.21 (0.180)	3.84 (0.142)	4.22 (0.038)
1000+	-	4.21 (0.179)	-	4.67 (0.062)
Age				
0 - 5	3.57 (0.020)	3.96 (0.039)	3.75 (0.011)	4.12 (0.020)
5 -10	3.55 (0.024)	3.93 (0.052)	3.73 (0.012)	4.17 (0.022)
10+	3.56 (0.021)	3.86 (0.026)	3.76 (0.007)	4.15 (0.010)
Rural	3.42 (0.029)	3.64 (0.045)	3.63 (0.013)	4.04 (0.017)
Urban	3.60 (0.015)	3.99 (0.022)	3.78 (0.006)	4.18 (0.009)

Labor productivity is measured as that natural log of valued added per worker. The values in the table are cell means and their associated standard errors. Missing values are omitted to prevent disclosure of individual establishment data.

Table 5-A
Single Unit Probit Estimates with 1992 Characteristics
Dependent Variable = 1 if plant survives from 1992 to 1996

	All Plants		SMEs	
	Unweighted	Weighted	Unweighted	Weighted
Constant	0.232** (0.100)	-0.374* (0.127)	0.594* (0.169)	0.616* (0.183)
Extension Client	0.006 (.0.060)	-0.008 (0.047)	-0.006 (.0.071)	-0.005 (0.065)
Age: 0 - 5 years	-0.496* (0.028)	-0.474* (0.031)	-0.476* (0.046)	-0.479* (0.047)
Age: 5 - 10 years	-0.180* (0.033)	-0.252* (0.035)	-0.226* (0.051)	-0.273* (0.052)
Age: over 10 years	-	-	-	-
Log(K/TE) (capital intensity)	0.022*** (0.013)	0.048** (0.014)	0.029 (0.019)	0.057* (0.020)
Log(VA/TE) (labor productivity)	0.158* (0.020)	0.192* (0.023)	0.197* (0.033)	0.206* (0.034)
Urban	0.005 (0.032)	0.011 (0.034)	0.025 (0.050)	0.018 (0.049)
Multi-Unit	5.165 (6478.8)	5.304 (3745.2)	NA	NA
Size: 1000#TE	5.465 (1560.4)	5.697 (1568.3)	NA	NA
Size: 500#TE<1000	0.691* (0.155)	0.462* (0.073)	0.281*** (0.157)	0.205* (0.074)
Size: 250#TE<500	0.413* (0.063)	0.236* (0.061)	0.003 (0.063)	-0.023 (0.050)
Size: 100#TE<250	0.408* (0.046)	0.247* (0.060)	0.011 (0.045)	-0.006 (0.048)
Size: 50#TE<100	0.392* (0.033)	0.249* (0.058)	-	-
Size: 20#TE<50	0.294* (0.032)	0.161** (0.063)	NA	NA
Size: 10#TE<20	-	-	NA	NA
N	17161	17161	7991	7991
Log L	-6936.4	-5877.3	-2741.2	-2689.7

* denotes coefficient estimate is significant at the 0.01 level, ** denotes significant at the 0.05 level and *** denotes significant at the 0.10 level. All probits also include 2 digit SIC and state

dummies. Standard errors in parentheses.

Table 5-B
Single Unit Probit Estimates with 1987 Characteristics
Dependent Variable = 1 if plant survives from 1992 to 1996

	All Plants		SMEs	
	Unweighted	Weighted	Unweighted	Weighted
Constant	0.254** (0.131)	-0.085 (0.163)	0.067 (0.183)	-0.095 (0.196)
Extension Client	0.122*** (0.068)	0.202* (0.056)	0.215* (0.080)	0.195* (0.072)
Age: 0 - 5 years	NA	NA	NA	NA
Age: 5 - 10 years	-0.193* (0.036)	-0.222* (0.040)	-0.300* (0.052)	-0.273* (0.055)
Age: over 10 years	-	-	-	-
Log(K/TE) (capital intensity)	0.063* (0.018)	0.078* (0.019)	0.115 (0.025)	0.101* (0.026)
Log(VA/TE) (labor productivity)	0.092* (0.028)	0.221* (0.030)	0.157* (0.040)	0.237* (0.041)
Urban	-0.013 (0.040)	-0.052 (0.038)	-0.069 (0.054)	-0.081 (0.052)
Multi-Unit	4.987 (4580.8)	5.166 (1786.4)	NA	NA
Size: 1000#TE	0.238 (0.408)	0.162 (0.132)	NA	NA
Size: 500#TE<1000	0.132 (0.160)	0.082 (0.102)	0.002 (0.158)	-0.016 (0.078)
Size: 250#TE<500	0.061 (0.074)	0.014 (0.091)	-0.032 (0.068)	-0.054 (0.054)
Size: 100#TE<250	0.111** (0.056)	0.071 (0.090)	0.033 (0.049)	0.011 (0.052)
Size: 50#TE<100	0.075*** (0.045)	0.055 (0.088)	-	-
Size: 20#TE<50	0.148* (0.045)	0.131 (0.095)	NA	NA
Size: 10#TE<20	-	-	NA	NA
N	11571	11571	6242	6242
Log L	-4469.6	-4466.2	-2391.2	-2427.4

* denotes coefficient estimate is significant at the 0.01 level, ** denotes significant at the 0.05 level and *** denotes significant at the 0.10 level. All probits also include 2 digit SIC and state dummies. Standard errors in parentheses.

Table 6-A
Multi-Unit Probit Estimates (Without Firm Effects) with 1992 Characteristics
Dependent Variable = 1 if plant survives from 1992 to 1996

	All Plants		SMEs	
	Unweighted	Weighted	Unweighted	Weighted
Constant	-0.126 (0.171)	-0.296 (0.341)	0.237 (0.193)	-0.016 (0.212)
Extension Client	0.060 (0.063)	0.092 (0.062)	0.035 (0.068)	0.060 (0.064)
Age: 0 - 5 years	-0.099** (0.040)	-0.101*** (0.059)	-0.071 (0.049)	-0.085 (0.058)
Age: 5 - 10 years	-0.069 (0.045)	0.020 (0.069)	-0.055 (0.054)	0.016 (0.064)
Age: over 10 years	-	-	-	-
Log(K/TE) (capital intensity)	0.080* (0.016)	0.186* (0.023)	0.105* (0.020)	0.149* (0.023)
Log(VA/TE) (labor productivity)	0.144* (0.023)	0.074* (0.029)	0.141* (0.028)	0.143* (0.030)
Urban	-0.095** (0.038)	-0.050 (0.044)	-0.136* (0.045)	-0.114** (0.046)
Multi-Unit	1.595* (0.215)	1.694* (0.278)	NA	NA
Size: 1000#TE	1.119* (0.106)	1.025* (0.271)	NA	NA
Size: 500#TE<1000	0.883* (0.075)	0.820* (0.269)	.380* (0.066)	0.388* (0.078)
Size: 250#TE<500	0.687* (0.061)	0.624** (0.268)	0.186* (0.049)	0.191* (0.074)
Size: 100#TE<250	0.616* (0.060)	0.538** (0.270)	0.116** (0.049)	0.093 (0.082)
Size: 50#TE<100	0.497* (0.058)	0.446 (0.275)	-	-
Size: 20#TE<50	0.341* (0.064)	0.315 (0.306)	NA	NA
Size: 10#TE<20	-	-	NA	NA
N	10481	10481	7735	7735
Log L	-4246.3	-2647.6	-3037.9	-2684.1

* denotes coefficient estimate is significant at the 0.01 level, ** denotes significant at the 0.05 level and *** denotes significant at the 0.10 level. All probits also include 2 digit SIC and state

dummies. Standard errors in parentheses.

Table 6-B
Multi-Unit Probit Estimates (Without Firm Effects) with 1987 Characteristics
Dependent Variable = 1 if plant survives from 1992 to 1996

	All Plants		SMEs	
	Unweighted	Weighted	Unweighted	Weighted
Constant	-0.097 (0.209)	0.117 (0.444)	0.371 (0.237)	0.308 (0.270)
Extension Client	0.088 (0.069)	0.143** (0.071)	0.049 (0.073)	0.054 (0.070)
Age: 0 - 5 years	NA	NA	NA	NA
Age: 5 - 10 years	-0.095** (0.045)	-0.024 (0.072)	-0.063 (0.054)	0.024 (0.066)
Age: over 10 years	-	-	-	-
Log(K/TE) (capital intensity)	0.037** (0.018)	0.054** (0.025)	0.022 (0.021)	0.074* (0.024)
Log(VA/TE) (labor productivity)	0.226* (0.025)	0.151* (0.031)	0.204* (0.030)	0.200* (0.032)
Urban	-0.126* (0.041)	-0.062 (0.049)	-0.180* (0.048)	-0.159* (0.050)
Multi-Unit	1.778* (0.243)	1.888* (0.356)	NA	NA
Size: 1000#TE	1.171* (0.115)	1.102* (0.347)	NA	NA
Size: 500#TE<1000	0.965* (0.085)	0.926* (0.346)	.493* (0.071)	0.533* (0.088)
Size: 250#TE<500	0.724* (0.073)	0.675*** (0.345)	0.259* (0.053)	0.287* (0.085)
Size: 100#TE<250	0.610* (0.072)	0.525 (0.348)	0.145* (0.054)	0.131 (0.094)
Size: 50#TE<100	0.469* (0.081)	0.399 (0.354)	-	-
Size: 20#TE<50	0.372* (0.081)	0.325 (0.398)	NA	NA
Size: 10#TE<20	-	-	NA	NA
N	8420	8420	6441	6441
Log L	-3326.8	-2069.8	2526.9	-2207.8

* denotes coefficient estimate is significant at the 0.01 level, ** denotes significant at the 0.05 level and *** denotes significant at the 0.10 level. All probits also include 2 digit SIC and state dummies. Standard errors in parentheses.

Table 7-A
Multi-Unit Probit Estimates (With Firms Effects) with 1992 Characteristics
Dependent Variable = 1 if plant survives from 1992 to 1996

	All Plants		SMEs	
	Unweighted	Weighted	Unweighted	Weighted
Constant	0.139 (0.297)	0.726 (0.500)	0.496 (0.363)	0.193 (0.390)
Extension Client	0.060 (0.063)	0.077 (0.064)	0.027 (0.068)	0.053 (0.065)
Age: 0 - 5 years	-0.090** (0.040)	-0.087 (0.060)	-0.062 (0.049)	-0.081 (0.058)
Age: 5 - 10 years	-0.060 (0.046)	0.043 (0.070)	-0.042 (0.054)	0.022 (0.065)
Age: over 10 years	-	-	-	-
Log(K/TE) (capital intensity)	0.091* (0.017)	0.202* (0.023)	0.112* (0.020)	0.162* (0.023)
Log(VA/TE) (labor productivity)	0.163* (0.024)	0.119* (0.032)	0.152* (0.030)	0.178* (0.032)
Urban	-0.087** (0.038)	-0.052 (0.045)	-0.133* (0.045)	-0.111** (0.046)
Firm Profits per Worker	-0.058 (0.060)	-0.367** (0.150)	-0.042 (0.123)	-0.220 (0.145)
Log(Plant Sh. of Firm L)	0.164* (0.028)	0.272* (0.043)	0.170* (0.044)	0.183* (0.048)
# of plans in same 4 digit sic = 1	-	-	-	-
# of plants in same 4 digit sic = 2	0.224* (0.043)	0.217* (0.056)	0.207* (0.051)	0.166* (0.055)
2< # of plants in same 4 digit sic # 5	0.266* (0.044)	0.248* (0.054)	0.232* (0.053)	0.226* (0.055)
5 < # of plants in same 4 digit sic	0.417* (0.056)	0.349* (0.067)	0.302* (0.066)	0.221* (0.068)
# of 2 digit industries firm is in = 1	-	-	-	-
1< # of 2 digit industries firm is in # 3	0.100** (0.043)	0.038 (0.056)	0.118** (0.052)	0.091 (0.058)
3< # of 2 digit industries firm is in	0.289* (0.068)	0.343* (0.085)	0.311* (0.081)	0.269* (0.085)
Firm TE < 100	-0.217 (0.206)	-0.909* (0.299)	-0.373 (0.290)	-0.434 (0.312)

100 # Firm TE < 500	-0.104	-0.557**	-0.182	-0.178
	(0.166)	(0.232)	(0.236)	(0.245)
500 # Firm TE < 1000	-0.045	-0.272	-0.152	-0.048
	(0.147)	(0.198)	(0.201)	(0.209)
1000 # Firm TE < 5000	-0.053	-0.262***	-0.073	0.041
	(0.117)	(0.151)	(0.157)	(0.159)
5000 # Firm TE < 10000	0.003	-0.129	-0.074	0.093
	(0.107)	(0.121)	(0.131)	(0.127)
10000 # Firm TE < 25000	0.184***	0.058	0.110	0.125
	(0.096)	(0.092)	(0.111)	(0.097)
Firm TE $ 25000	-	-	-	-
N	10481	10481	7735	7735
Log L	-4189.8	-2589.9	-3007.6	-2646.5

* denotes coefficient estimate is significant at the 0.01 level, ** denotes significant at the 0.05 level and *** denotes significant at the 0.10 level. All probits also include 2 digit SIC, plant size and state dummies. Standard errors in parentheses.

Table 7-B
Multi-Unit Probit Estimates (With Firms Effects) with 1987 Characteristics
Dependent Variable = 1 if plant survives from 1992 to 1996

	All Plants		SMEs	
	Unweighted	Weighted	Unweighted	Weighted
Constant	0.210 (0.350)	1.042*** (0.611)	0.477 (0.415)	0.528 (0.455)
Extension Client	0.092 (0.070)	0.132*** (0.072)	0.044 (0.074)	0.048 (0.071)
Age: 0 - 5 years	NA	NA	NA	NA
Age: 5 - 10 years	-0.081*** (0.045)	-0.054 (0.073)	-0.048 (0.054)	0.039 (0.067)
Age: over 10 years	-	-	-	-
Log(K/TE) (capital intensity)	-0.023 (0.018)	0.072* (0.026)	0.033 (0.022)	0.090* (0.025)
Log(VA/TE) (labor productivity)	0.259* (0.027)	0.197* (0.035)	0.224* (0.032)	0.242* (0.035)
Urban	-0.122** (0.042)	-0.067 (0.050)	-0.181* (0.048)	-0.166* (0.050)
Firm Profits per Worker	-0.248** (0.114)	-0.377** (0.165)	-0.122 (0.129)	-0.265*** (0.153)
Log(Plant Sh. of Firm L)	0.180* (0.033)	0.267* (0.080)	0.171* (0.049)	0.217* (0.054)
# of plans in same 4 digit sic = 1	-	-	-	-
# of plants in same 4 digit sic = 2	0.222* (0.049)	0.237* (0.063)	0.229* (0.056)	0.193* (0.054)
2< # of plants in same 4 digit sic # 5	0.274* (0.050)	0.291* (0.061)	0.239* (0.058)	0.258* (0.061)
5 < # of plants in same 4 digit sic	0.432* (0.062)	0.395* (0.075)	0.330* (0.072)	0.270* (0.075)
# of 2 digit industries firm is in = 1	-	-	-	-
1< # of 2 digit industries firm is in # 3	0.137* (0.049)	0.029 (0.067)	0.153** (0.057)	0.133** (0.063)
3< # of 2 digit industries firm is in	0.359* (0.078)	0.392* (0.097)	0.367* (0.089)	0.380* (0.093)
Firm TE < 100	-0.299 (0.238)	-0.873** (0.344)	-0.273 (0.321)	-0.498 (0.349)
100 # Firm TE < 500	-0.139 (0.190)	-0.495*** (0.267)	-0.090 (0.260)	-0.194 (0.274)

500 # Firm TE < 1000	-0.051 (0.167)	-0.222 (0.227)	-0.049 (0.222)	-0.051 (0.234)
1000 # Firm TE < 5000	-0.020 (0.132)	-0.212 (0.173)	0.039 (0.172)	0.064 (0.176)
5000 # Firm TE < 10000	0.001 (0.117)	-0.113 (0.137)	-0.002 (0.142)	0.118 (0.140)
10000 # Firm TE < 25000	0.137 (0.103)	0.076 (0.103)	0.121 (0.118)	0.163 (0.106)
Firm TE $ 25000	-	-	-	-
N	8420	8420	6441	6441
Log L	-3276.4	-2020.5	-2495.0	-2165.6

* denotes coefficient estimate is significant at the 0.01 level, ** denotes significant at the 0.05 level and *** denotes significant at the 0.10 level. All probits also include 2 digit SIC, plant size and state dummies. Standard errors in parentheses.